(12) UK Patent Application (19) GB (11) 2 009 884 A

(21) Application No. 7843169
(22) Date of filing 3 Nov 1978
(23) Claims filed 3 Nov 1978
(30) Priority data
(31) 2752633
(32) 25 Nov 1977
(33) Fed. Rep of Germany (DE)
(43) Application published
20 Jun 1979
(51) INT CL^2
F02F 1/00
(52) Domestic classification
F2T 1 37AX 37X3 7 HX3
F1B 2A7 2C11 2C15A
(56) Documents cited
F1B
F2T
(58) Field of search
GB 676740

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(54) **A cylinder for a reciprocating-piston internal combustion engine**

(57) The head of an engine cylinder (1) is fitted with a ring (4) having a bore forming a local constriction of the cylinder, the bore having a taper corresponding to that of the top land (3) of the piston (2). This arrangement is intended to reduce the risk of engine seizure by avoiding loosening of any deposits and overheating of the head end of the cylinder.

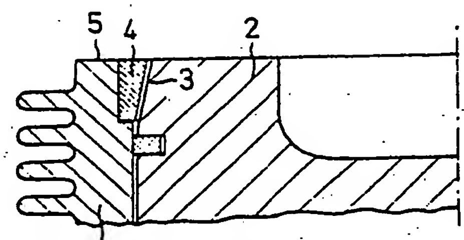

FIG.1

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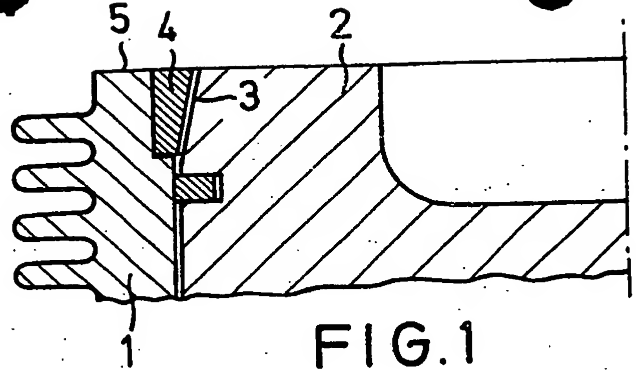

FIG.1

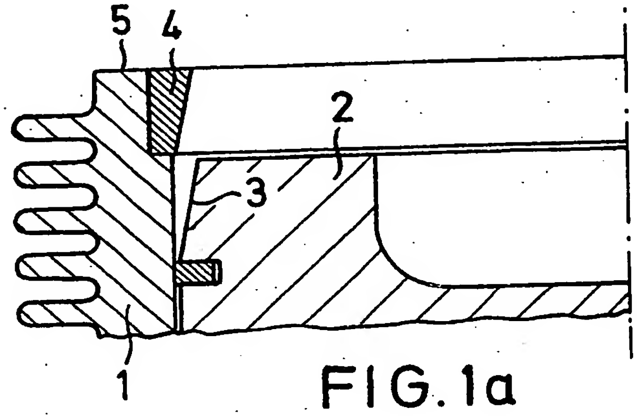

FIG.1a

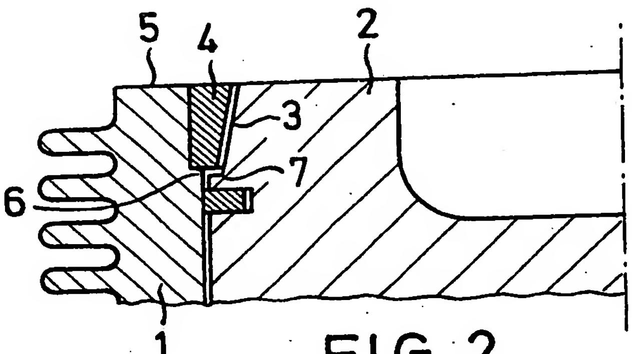

FIG.2

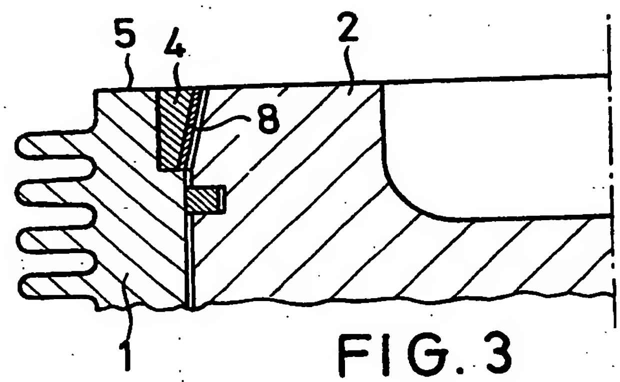

FIG.3

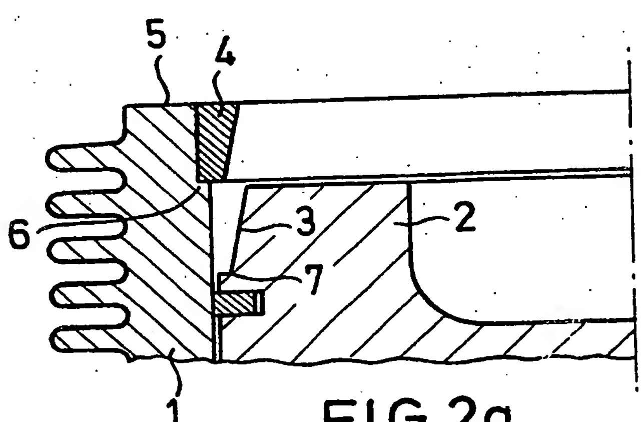

FIG.2a

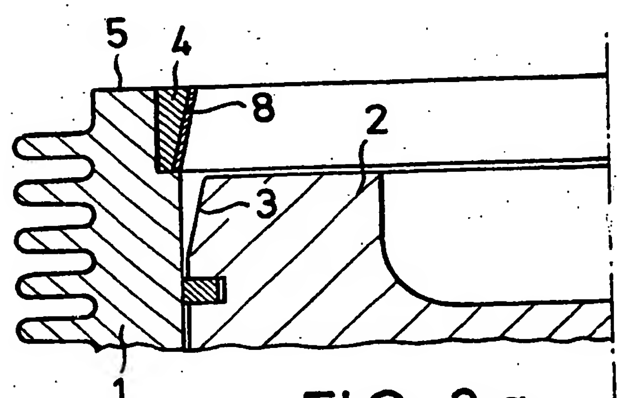

FIG.3a

SPECIFICATION

A cylinder for a reciprocating-piston internal combustion engine

This invention relates to a cylinder for a reciprocating-piston internal combustion engine, in which the cylinder diameter is reduced by a ring inserted into the cylinder at the cylinder head end, adjacent the top land of the piston when in the top dead-centre position.

A completely tight seal is desirable between the piston and the cylinder, and this depends largely on the thermal expansion of the two parts and on their geometrical shapes. If cast cylinders are used with light-metal pistons, the clearances are larger when cold and the geometrical shapes must allow for thermal expansion.

Pistons are usually made smaller in diameter in the region which is most intensely heated, i.e., at the closed end, than along the body. The result is a substantially cylindrical shape at the operating temperature, with the minimum piston clearance in the cylinder.

It is known to alter the shape of the cylinder by reducing its diameter at the end occupied by the closed end of the piston when at its top dead-centre position in the cylinder. The purpose of shaping the cylinder and the piston in this manner is to ensure that, during operation, there is a very uniform, narrow clearance between the cylinder and the piston all the way along the cylinder.

It is found by experience that oil carbon and combustion residues deposited on the piston, depending on the state of operation, amy result in seizing-up. The top land of the piston is particularly liable to this effect. For this reason, it has also been proposed to give the piston a stepped diameter near the top land and to insert a ring in the upper region of the cylinder. As a result the portion on which oil carbon and combustion residues are mainly deposited is of smaller diameter than the cylinder, so that deposits cannot damage the surface of the cylinder, when the piston moves. The gap between the top land and the inserted ring must be of limited size, since it is always desired to obtain the maximum compression in the combustion chamber; consequently, if the layer grows thicker and finally touches the ring, parts of the layer come loose and damage the cylinder surface.

The aforementioned arrangement, in which the inserted ring has surfaces parallel to the axis, cannot eliminate a frequent cause of seizing-up, or jamming of the piston, i.e., when the cylinder suddenly cools after extreme over-heating, as may occur when travelling downhill with air-cooled cylinders, because the piston does not cool quickly enough and is gripped by the contracting cylinder.

An object of the invention is to relieve the heating of the top part of the cylinder and to ensure that deposits of oil carbon and combustion residues in the neighbourhood of the top land are substantially harmless at the top dead-centre position of the piston, thus preventing jamming of the piston or loosening of the deposits.

To this end, the invention provides a cylinder for a reciprocating-piston internal combustion engine having the cylinder bore diameter locally reduced by a ring inserted in the cylinder head end of the cylinder, adjacent the top land of the piston when the piston is in its top dead-centre position, in which the reduction of the cylinder bore diameter is produced by continuous tapering of the bore diameter of the inserted ring.

As a result of the continuous tapering the piston moves at a certain distance from the cylinder wall and does not approach it most closely until it reaches its top dead-centre position. Consequently, in contrast to the case of axially parallel surfaces, no crust or layer is cut or rubbed off even after the top land has become progressively carbonized. Instead, the carbon is prevented from increasing by the pressure contact resulting from the component of motion, perpendicular to the surfaces, of the approaching surfaces of the piston and ring. The bore of the inserted ring may, if desired, by frusto-conical.

According to another optional feature of the invention, the continuous tapering may start from a diameter which is slightly different from the cylinder diameter. As a result, the cylinder is not appreciably weakened in its top region, so that it and the piston can be subsequently reconstructed without having to reinforce the cylinder wall.

According to a further optional feature, in order to hold the ring against the cylinder irrespective of the amount of thermal expansion, the inserted ring is clamped in the axial direction between the sealing surface of a cylinder head when assembled with the cylinder and a shoulder in the cylinder bore. The same clamping means can be used to provide a heat-insulating air gap between the ring and the cylinder, thus protecting the top region of the cylinder from overheating. In that case, the bore of the ring must be coated with a hightly heat-resistant and/or heat-insulating material.

Embodiments of the invention are diagrammatically shown in the accompanying drawings, in which:-

Figure 1 is a vertical section through the cylinder head end of a piston and cylinder with the piston in its top dead-centre position;

Figure 1a is a similar view of the same piston and cylinder with the piston below the dead-centre position;

Figures 2 and 2a are views corresponding to Figures 1 and 1*a* showing a modification; and

Figures 3 and 3a are views corresponding to Figures 1 and 1*a* showing a further modification.

Referring to the drawings, Figure 1 shows the cylinder 1 of an air-cooled internal combustion engine comprising a piston 2 which is in its top dead-centre position. A ring 4 is inserted in the cylinder wall adjacent the top land 3 of the piston 2 and is clamped with the sealing surface 5 of cylinder 1 to a cylinder head (not shown). Ring 4, which is made of nodular cast iron or highly heat-resistant steel, can be pressed or shrunk into cylinder 1. The bore of ring 4 tapers continuously from the cylinder diameter to a smaller diameter at the sealing surface

5 for the cylinder head. The bore of the ring is frusto-conical. The top land of the piston 2 is shaped to correspond. The result, as shown in Figure 1*a*, is that as long as piston 2 is not in the top dead-centre position, the space between the top land 3 and the bore of ring 4 is sufficient to prevent deposits from forming on the top land of the piston as a result of the special flow conditions.

In Figures 2 and 2*a*, in contrast to Figures 1 and 1*a*, the maximum bore diameter of ring 4 is less than the diameter of cylinder 1. Because of the resulting step in cylinder 1, a shoulder 7 is needed in piston 2 near the top land 3. If the wall of ring 4 is sufficiently thick, this embodiment takes up less space in cylinder 1, so that its wall does not need to be thickened on the outside.

Figures 3 and 3*a* show an embodiment similar to that of Figures 1 and 1*a* except that the ring is coated with a heat-resisting and/heat-insulating ceramic layer 8 in its frusto-conical bore. This screens heat from the highly-heated top part of the cylinder. If the combustion chamber is less highly heated, the layer may also be of chromium. Alternatively, a small air gap can be provided for heat insulation between ring 4 and cylinder 1.

If, as a result of varying thermal expansion or an air gap, there is insufficient adhesion between ring 4 and cylinder 1, ring 4 can be axially clamped by the pressure of the cylinder head (not shown in detail) between shoulder 6 in cylinder 1 and the sealing surface 5 of the cylinder head.

CLAIMS

1. A cylinder for a reciprocating-piston internal combustion engine having the cylinder bore diameter locally reduced by a ring inserted in the cylinder head end of the cylinder, adjacent the top land of the piston when the piston is in its top dead-centre position, in which the reduction of the cylinder bore diameter is produced by continuous tapering of the bore of the inserted ring.

2. A cylinder according to claim 1, in which the bore of the ring is frusto-conical.

3. A cylinder according to claim 1 or claim 2, in which the continuous tapering starts from a diameter which is slightly different from the cylinder bore diameter.

4. A cylinder according to any preceding claim, in which the inserted ring is clamped in the axial direction between the sealing surface of a cylinder head (when assembled with the cylinder) and a shoulder in tye cylinder bore.

5. A cylinder according to any preceding claim, in which the bore of the inserted ring is coated with a heat-resisting and/or heat-insulating material.

6. A cylinder for a reciprocating-piston internal combustion engine, constructed and arranged substantially as herein described, with reference to and as illustrated in Figures 1 and 1*a*, or Figures 2 and 2*a*, or Figures 3 and 3*a*, of the accompanying drawings.

Printed for Her Majesty's Stationery Office by Croydon Printing Company Limited, Croydon Surrey, 1979.
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